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A NOTE ON THE VALUDAVUR METEORITE 1952.

By

A. K. DEY, B.Sc., Ph.D., D.I.C.
Superintending Geologist,
Geological Survey of India.

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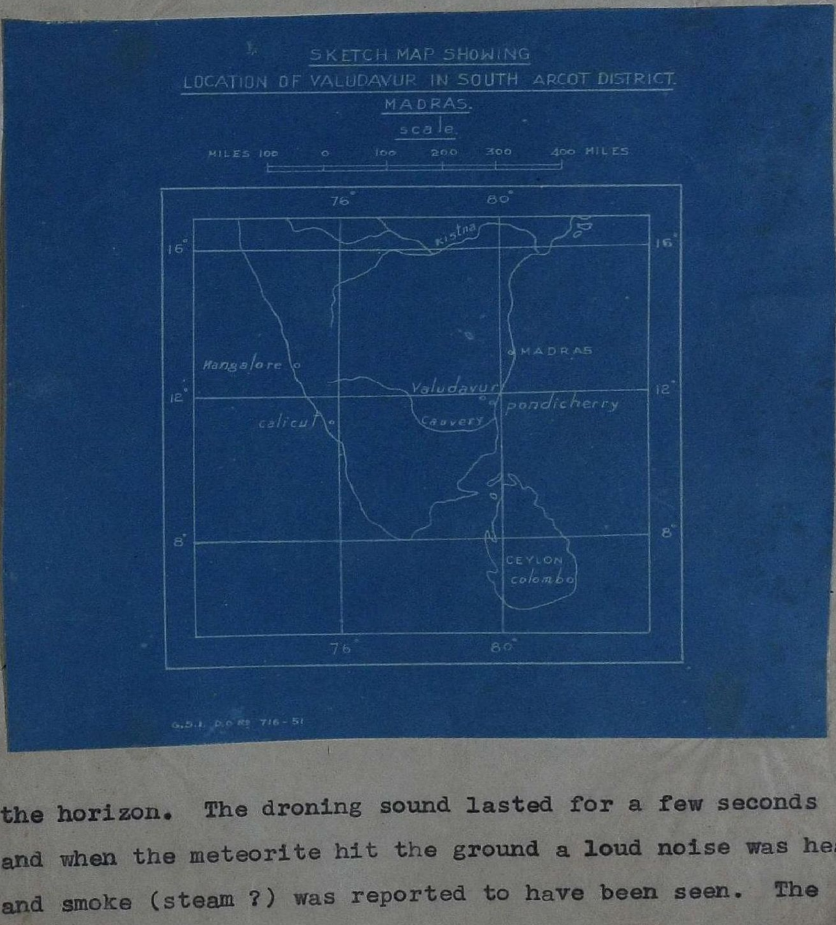
At Valudavur (11°59' : 79°42'), 10 miles north-west of Pondicherry, in the South Arcot district of Madras, in the bright afternoon of October 30, 1944, between 5 and 5.30 P.M., a meteorite fell with a droning sound as that of an aircraft engine, on a wet paddy-field, about 50 yards west of Vanur-Kandamangalam road and 150 yards from and opposite to the Board Higher Elementary School. It came from a westerly direction, making an approximate angle of 60° with



the horizon. The droning sound lasted for a few seconds and when the meteorite hit the ground a loud noise was heard and smoke (steam ?) was reported to have been seen. The local people thinking it to be a bomb, buried the meteorite under a mound of earth and cow-dung. Curiously enough, the

Rangala meteorite which fell at about 10 O' clock in the morning of the 29th December, 1937 at Rangala in Jodhpur, Rajasthan, was at first thought by the villagers to be a bomb dropped by a passing aeroplane[1]. A small crater 6 inches in diameter and about the same depth was formed on the spot where it hit the ground. The meteorite was collected by Mr. Londsdale, Superintendent of Police, South Arcot district. Mr. R.N.P. Arogyaswamy of the Geological Survey of India, hearing of this, inspected the meteorite and later took Dr. H. Crookshank, Offg. Director, Geological Survey of India, who was on an inspection tour, to see the specimen. Meanwhile, the Government of Madras had passed orders to Mr. Londsdale to deposit the meteorite with the Madras Museum. Thereon, Dr. Crookshank addressed the Government of Madras drawing their attention to the Government of India order that all meteorites falling within the Indian Empire are the property of the Geological Survey of India. The earlier order of the Government of Madras was cancelled and the meteorite was sent to the Geological Survey of India. Later on, Mr. R.N.P. Arogyaswamy visited the spot in company with the Sub-Inspector of Police, Vanur, on February 7, 1945 and met the village headman and the Assistant School Master who had seen the fall, but could not obtain any further details of the fall or traces of any splinters. There was an earthen mound around the pit where the meteorite fell.

The meteorite was found to be an aerolite or meteoric stone weighing about 27.99 grms. In shape it is a more or less rhomboidal resembling a half-broken boulder, and measuring 17.3 cm. lengthwise, 13.2 cm. breadthwise and 7 cm. in thickness, the longest diagonal being 18.7 cm. One side is convex, bluntly pointed (apex) and elevated at the edge; the opposite side is slightly concave with a fairly sharp edge which is broken at two places. Superficial

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[1]Rec. Geol. Surv. Ind., 74, p.260 (1939)

crust is of steel grey colour, 0.1 to 0.7 mm. in thickness, finely granular and at the concave side somewhat slaggy locally; it is not continuous near the presumed point of impact, where flakes of the body appear to have been struck off near the edges. The interior, as seen at the broken edges, is dirty bluish grey, with rusty patches due to the decomposition of ferruginous minerals. Chondritic structure is not readily apparent but may be seen at the broken edges where partially exposed chondri about a millimetre or less in diameter appear like embedded steel-grey shots. The thinness of the superficial crust is presumably due to poor conductivity and higher fusion temperature of the material composing the meteorite; besides, as the meteorite penetrated the earth's atmosphere at a steep angle, its period of flight was short and consequently the frictional heat generated at the surface was limited. The blunt edges are due to the wearing away of sharp points of the meteorite during its journey to the earth by heat and friction produced by the resistance offered by the atmosphere. The steep angle of descent, and the general form, may indicate that it was a fragment of a larger body which exploded in the atmosphere, the remainder continuing at lower angles and possibly falling in the Bay of Bengal or being reduced to dust.

In thin sections under the microscope, the meteorite is mainly made up of crystals of olivine and enstatite set in the ground mass of nickel-iron ore showing under reflected light grey-white colour with a bluish tinge suggestive of kamacite. The kamacite, particularly in the superficial crust, has a black rim of some dark opaque mineral. The olivine and enstatite occur both as phenocrysts and as minute grains and laths. Some colourless grains with a shagreen appearance have the birefringence and refractive index of apatite and may therefore be merrillite. A few lath-shaped colourless grains about 0.1 mm. in length are also seem to be present

often occurring interstitially with rods of enstatite. They appear to have refractive index higher than that of Canada balsam and are isotropic; a few other similar grains show an interferance colour of low order——these may be maskalynite. Occasionally the grains exhibit undulatory extinction.

The chondritic structure peculiar to most stone meteorites is very apparent in thin sections. The chondri are mostly drawn out, though some are slightly elongated or broken; the maximum size of chondri being 2 mm. across. The polysomatic chondri are composed essentially of olivine with or without fibrous laths or rods of enstatite set in a ground mass of kamacite. Sometimes the enstatite laths are eccentrically radiating. In the section of the superficial crust, there appears to be greater concentration of kamacite bordered with a rim of opaque mineral. Some glass is also seen and the cracks developed seem to have been cemented by glass.

Various hypotheses have been suggested for the chondritic structure but so far none seems to account fully for all the features present in the chondri.

According to Sir Lewis Fermor[1] the chondri have been formed from garnets on the sudden release of pressure, enabling each garnet to liquify under excessive heat; the sudden reduction in pressure, allowing the garnet molecules to break down into the more bulky enstatite, iron-oxide etc., was followed by a rapid decrease in temperature with the production of various radiated structures of enstatite, with the iron usually reduced by carbon or other agents from the matrix, and segregated outside the chondri. The almost explosive expansion of the garnets causes brecciation of the matrix around them. Since the garnet would be entirely

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[1]Fermor, L.L. Preliminary Note on the Origin of Meteorites Jour. & Proc. of As. Soc. Beng., N.S. VIII, pp. 315-324 (1917).

transformed, no traces of it can usually be found in stony meteorites. In the present case, there is no suggestion of brecciation in the section examined.

A sample from the interior of the specimen was coarsely ground, and magnetically separated, 20.21% being attracted by the magnet. The unattracted portion was further divided into portions soluble and insoluble in HCl, giving 3 fractions which were subjected to separate chemical analysis. The final bulk-analysis was calculated by recombining the separate figures.

	Attracted portion.	Unattracted portion			Bulk analysis.
	Attracted portion %	Soluble in Hcl. %	Insoluble in Hcl. %	Total % of unattracted portion.	%
Iron	74.18	--	--	--	14.99
Nickel	7.96	--	--	--	1.61
Cobalt	1.23	--	--	--	0.25
Silica (SiO_2)	1.95	29.44	54.61	41.75	34.89
Fe(as $Fe_{11}S_{12}$)	0.72	7.36	--	3.76	3.15
FeO	1.20	16.30	8.55	12.51	10.41
Fe_2O_3	0.23	3.21	--	1.64	1.36
Al_2O_3	0.38	2.98	9.16	6.00	5.06
TiO_2	Trace	0.10	0.25	0.17	0.14
NiO	--	Trace	--	Trace	Trace
CaO	0.22	1.10	3.33	2.19	1.86
MgO	2.50	34.17	22.95	28.68	23.90
Alkalies Na_2O	--	--	1.08		0.44
K_2O	--	--	0.46		0.017
S	0.45	4.62	--	2.36	1.97
P	Trace	--	--	--	--
Insoluble	10.70	--	--		--
Total ..	101.72				

<u>Specific gravity</u> .. 3.546

% Metal 16.85

Ratio Fe + Co : Ni .. 9.47

" Fe : Ni .. 9.32

Elements found by both spectroscopic and chemical examination:

Fe, Ni, Co, Si, Al, Ca, Mg, Na.

Elements determined chemically, but not spectroscopically:

Ti, K, S and P.

Elements found spectroscopically but not determined chemically:

Elements not found spectroscopically and not determined chemically:

Dy, Gd, Ir, Li, Sc, Sr, Ta, Tm and Zr.

According to classification of Daly[1] the meteorite is an enstatite chondrite; its chemical composition roughly agreeing with average chemical analysis of Merrill's metal-bearing chondrite as quoted by Rankama and Sahama[2]:

		Per cent
Fe	..	12.15
FeO	..	14.79
Ni	..	1.57
Co	..	0.07
SiO_2	..	39.24
Al_2O_3	..	2.92
Ca_2O_3	..	0.48
MgO	..	22.99
CaO	..	2.45
Na_2O	..	0.89
K_2O	..	0.21
S	..	1.82
P_2O_5	..	0.27
TiO_2	..	0.15
Total	..	100.00

The norm of the meteorite shows:-

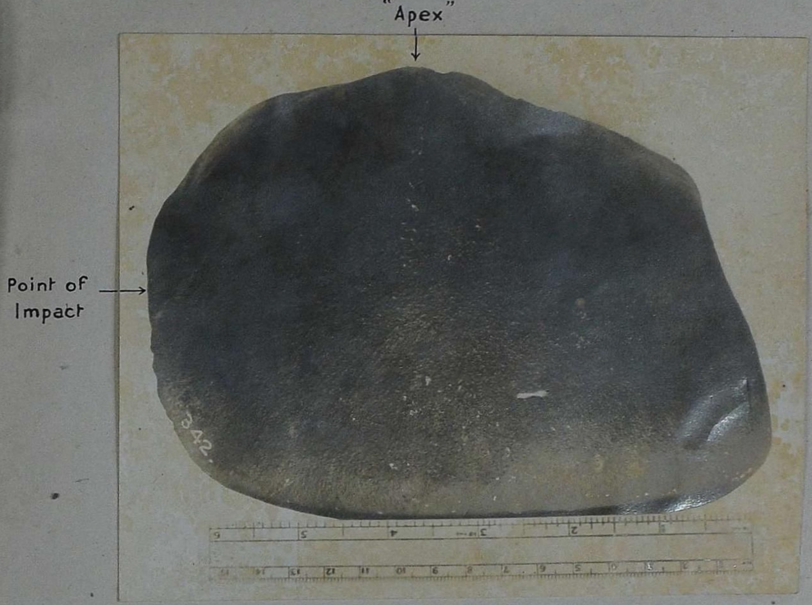
				Per cent
Albite	-	$NaAl\ Si_3O_8$	..	3.67
Anorthite	-	$CaAl_2\ Si_2O_8$	..	9.17
Hypersthene	-	$MgO.\ SiO_2$	..	21.00
		$FeO.\ SiO_2$	..	4.72
Olivine	-	$2MgO.\ SiO_2$	..	27.02
		$2FeO.\ SiO_2$	..	6.94
Corundum	-	Al_2O_3	..	0.92
Magnetite	-	$FeO.\ Fe_2O_3$	..	1.86
Ilmenite	-	$FeO.\ TiO_2$	..	0.30
Pyrites	-	FeS_2	..	3.72
Pyrrhotite	-	$Fe_{11}S_{12}$	..	3.15
Nickel-Iron	-	Fe	..	14.99
		Ni	..	1.61
		Co	..	0.25
				99.32

[1] Rankama, K. and Sahama, Th.G., Geochemistry, p. 29 (University of Chicago Press, 1950).

[2] *Ibid.*, p. 26.

The chemical analysis of the meteorite was done by Dr. V.T. Athavale and R.B. Ghosh while the spectrographic determinations were ~~are~~ by Dr. B. N. Bhaduri of the Tata Iron & Steel Company's ~~Tata~~ Research Laboratories, Jamshedpur

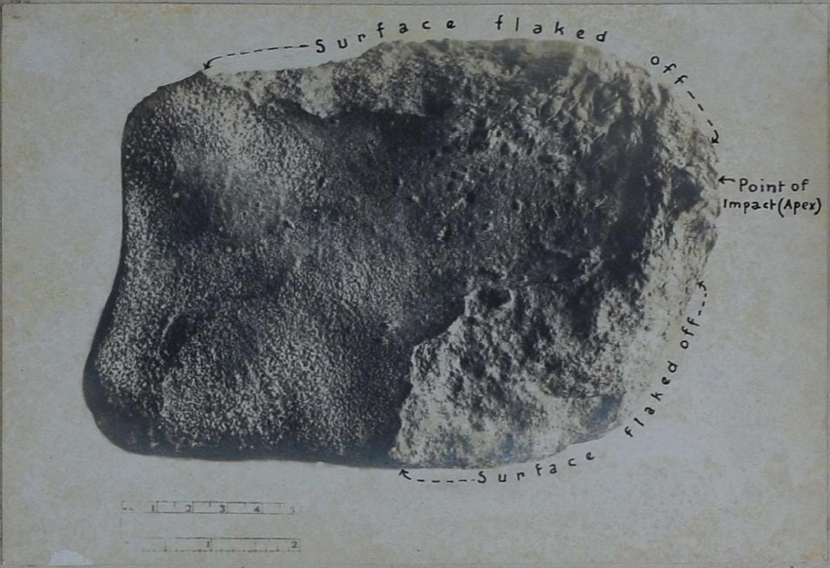
The meteorite has been registered under number 342 and microslides under 27249 in the collection of the Geological Survey of India.



Valudavur Meteorite
Convex Side

← Impact

Valudavur Meteorite
Side elevation (right side of convex plain view)
"Apex" in centre



Valudavur Meteorite
Concave side

File No.

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Collection No.

Pros./Serial Nos.

Subject.

Previous References.	Later References.